PROJECT BASED LEARNING MODEL IN THE BUILDING CONSTRUCTION AND DRAWING COURSE AT VOCATIONAL SCHOOL

Ikhwanuddin[1], Retna Hidayah[2], Sativa[3]

[1,2,3] Faculty of Engineering Yogyakarta State University
1ikhwan1din@gmail.com, 2 retnadewa@yahoo.com, 3sativa@uny.ac.id

Abstract

Graduate diploma in civil engineering is required not only understanding the structure of the system but also to understand as well as to produce project drawing documents. How to construct a suitable learning model to match the competence of civil engineering diploma graduates with the requirements of professional workforce is still in question. This paper aims to discuss the most appropriate model of Project Based Learning (PBL) to be applied in building construction drawing course on civil engineering diploma program. This model was developed through a comparative study of PBL models which are selected based on consideration of the suitability of "substance" and "order" procedure. Then the selected model is implemented in an action research on building construction drawings course in order to get the most appropriate model of PBL. The study concluded that the four phases of the Schneider's PBL model can be effectively applied in building construction and drawing course, but need to be modified especially in the content of procedure in the third (project implementation) and fourth (completion) phases.

Keywords: modified Schneider's model, Project Based Learning, building construction drawing course

1. Introduction

Learning process in the paradigm of student center learning requires students to cope with real problems and tasks in the workplace. Involving students in professional projects during the course will help students in understanding the work process and standards. In addition, the introduction and engagement of students in professional projects are expected to stimulate student motivation to improve their ability to fit the demands of professional work. This approach is also favorable for teachers, since with this approach they are expected to stimulate their competence both in teaching and learning process and adapting to the development of knowledge and technology.

Basic competencies to be achieved in the Building Construction and Drawing 2 (BCD 2) course that students are able to do prepare two-storey building structure and the details drawings properly. The kind of construction drawings to be completed consist of: reinforced-concrete structure for low-rise building, the steel roof construction, and building utility include of plumbing and electrical systems.

Since this course requires a comprehensive understanding of the whole system of the building, so far most of students have difficulty in completing their tasks. Their main problems include the difficulty of understanding the parts of the building systems, its functions and methods of construction, combining these parts into a whole building system, including to present project document according to drawings standard.

To address shortage and to improve the learning process of BCD 2, then the Project Based Learning teaching methods tested in this study. Project-based learning (PBL) is a learning approach that aims to encourage students to learn through real projects. (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991 in Zhou and Lee, 2009).

Several previous studies have been done before, such as research and Mokhtar Hashim Roslan Mohd Azizi Din (2009), Benjamin C. Cartier and Brad A. Gibson (2007), and Cynthia Hsieh and Lorrie Knight (2007) showed that the Project Based Learning teaching methods successfully improve the competence of students in learning, particularly in the field of engineering. The results of these studies has inspired the need to test this PBL method in BCD 2 courses through an action research, with consideration to the character of the course, condition of the student, and structure of the existing curriculum in the Department of Civil Engineering and Planning Education.

The purpose of this study was to find out the most appropriate model of PBL to be applied in building construction drawing course to improve the student competence in understanding and preparing low-rise building's structure drawings in accordance with professional drawing standards through the trial study method.

2. Method

In order to find out the most appropriate model of PBL to be applied in building construction

drawing course to improve the student competence, the study was conducted through many steps: First, do a comparative study of models of PBL: Second, do the selection of an appropriate model in accordance with the characteristics of the construction drawing course; Third, implement the model through classroom action research; Fourth, do an evaluation and construct pre-development model.

The model developed in this study is limited in the pre-model; it is an implementation test of the Schneider's PBL model as a reference model. This implementation test conducted in classroom action research at building construction and drawing course. The expected results of this study are: a description of the impact on model implementation, a description of the difficulties encountered during the implementation and finally a proposed model for the building construction drawing course.

3. Project Based Learning Model

3. 1. Model Development

Project Based Learning (PBL) is a collaborative teaching approach which places students in situations that require them to use all their capabilities to accomplish the project objectives. Project based learning will be able to nurture students' interest, if only the projects are well designed so as to increase a sense of curiosity and a higher level of thinking (Thomas, 1998).

PBL is a model of learning activities that are differently designed from the general classroom which characterized by teacher-centered management. Instead of that, PBL emphasizes classroom management activities based on a long-term, interdisciplinary, and student-centered learning characteristic. This model places the student at the center of learning and provides the opportunity for them to deeply study a wide range of topics. Model implementation provides benefits for students as they will be more independent when they themselves possible to discover and develop the importance of their learning process. (Egbokhare and Chiemeke, 2007).

Due to this learning model needs to be carried out by organizing learning in a project, classroom activities should be designed as a complex and comprehensive learning. Projects be completed by providing a challenging task or problem; involve students in learning design, problem solving, decision making, or the investigation to solve their problems; provide an opportunity for students to learn independently in a specified period and produce real products or presentations (Jones, Rasmussen, & Moffit, (1997), Thomas, Mergendoller, & Michaelson, (1999). In this implementation, process of learning carried out by applying a cooperative approach learning, reflection, and cooperation among adults (Diehl, Grobe, Lopez & Cabral, 1999).

PBL provides many benefits to the quality of student learning process, including: a) Increasing the attendance rate of students in the classroom, develop self-confidence, and improve attitudes toward learning process (Thomas, 2000), b) Students who are involved in project-based learning indicates significant progress in increasing their responsibility for their own learning than those who were involved in traditional classrooms (Boaler, 1997; SRI, 2000), c) Provide an opportunity for students to develop complex skills, such as thinking on a higher level, cooperating, and communicating (SRI, 2000), d) Allowing students engage in the job and work habits in a particular field, e) Provide an opportunity for students to organize their own learning activities, changing the way learning: from memorization and repetition to discover, integrate and present; from listening and reactive to communication and responsibility; from just acquiring knowledge about the facts, the term and the contents change into understand the process, from understanding theory to application of the theory (Intel, 2003).

Besides providing benefits to students, PBL model also provide benefits for teachers, including: a) Increase the professionalism and cooperation among teachers as well as provide the opportunity for teachers to build relationships with students (Thomas, 2000), and b) find an appropriate learning model to accommodate various types of learners (SRI, 2000).

There are two essential components of projects based learning: a) A driving question or problem that serves to organize and drive activities which taken as a whole amount to a meaningful project, b) culminating in the product or multiple representations as a series of artifacts, personal communication (Krajcik), or consequential task that meaningfully addresses the driving question. (Brown & Campione, 1994).

There are several models of PBL which possible to be applied in learning process, including PBL model of Tony Lagos, Paul Hamilton (2012), Daniel K Schneider (2006), BIE (2002), and Erika Baker or PEI (2011). PBL model of Tony Lagos consists of several steps, that is the general introduction, making the team learning, PBL implementation, inter-group meetings, and follow-up meetings, and evaluation.

Paul Hamilton model is composed of several steps consisting of activities such as get an idea, design the project, tune the project, do the project, and exhibit the project. While K Schneider model consists of several basic steps consist of the following activities: an explanation of the project specifications, the selection of projects by the group, arrange the project schedule, the feedback

mechanism both in the group and classroom, project presentations, and assessment.

BIE model consists of the following steps recognizing students' inherent drive to learn, highlighting provocative issues or questions, solve problems that specify products, performance-based assessments, multiple products that permit frequent feedback, and encouraging collaboration in small group and class.

PEI model comprises the following steps of: asking questions (for science) and defining problems (for engineering); developing and using models; planning and carrying out investigations; analyzing and interpreting data; using mathematics, information and computer technology, and computational thinking; constructing explanations (for science) and designing solutions (for engineering); engaging in argument from evidence; obtaining, evaluating, and communicating information.

3. 2. Appropriate Model Implementation

To get an appropriate PBL model for building construction and drawing course is necessary to study on several models in order to obtain an overview of advantages and disadvantages of each model. Before comparing each PBL model, it is needed to first describe the conventional learning procedure that based on teacher learning center to recognize its characteristics and shortage of this model.

Conventional learning on building construction drawing course can be generally described in the following activity: explanation of the project specification, determination of building projects, construction theory explanation, drafting of project drawings, frequent feedback, revision and improvement, and finally drawing submission. In this conventional method, the teacher took a dominant role in determining the project, explained the theory of construction associated with the project, provide feedback on student work, and assess the final project; while students usually work individually. This learning process is linear, monotone, individual, and controlled. Students are only passively accept the project, listening to lectures construction theory, receives input only from a teacher, and receive final project assessment is also dependent on a teacher.

These will be presented a comparison between PBL models to evaluate which model is most suitable according to the characteristics of a building construction course. Lagos Model consists of several steps, that is: general introduction, making the learning group, PBL implementation, inter-group meeting, follow-up meeting, and evaluation. Learning model developed by Lagos is still in general; it only emphasizes the importance of inter-group meetings and follow-up meeting. It seems difficult to totally convert the conventional learning of BCD 2 into this model.

PBL model developed by Paul Hamilton (2012) comprises the steps: get an idea, design the project, tune the project, do the project, and exhibit the project. Hamilton model is quite suitable to be applied at BCD 2. Conventional procedures in the form of "explanation of the project specification" and "determination of the project" can be converted into step "get an idea" and "design the project" in this model. While the step "progress" can be converted into "do the project". Steps "final project submission" can be converted into step "exhibit the project" in this model. Step "providing inputs" may be converted into step "tune the project", but the order process is still not in accordance with the characteristics of the task.

Schneider model consists of the following steps: an explanation of the project specifications, the selection of projects by the group, making the project schedule, project implementation, feedback mechanisms both within the group or classroom, improvement, project presentations, and assessment. It seems the whole of “substance of learning" and "order process" in the conventional method can be converted into this model. Significant difference is that the paradigm of learning in Schneider is no longer based on teacher learning center but student learning center. Students are required to participate actively in learning, and are no longer completing assignments on an individual basis only. Eventually be possible for them to present their final projects in classroom to get comments, feedback and assessment of inter-group; something that is not facilitated by the conventional method.

BIE and PEI models, also seems less in accordance with conventional methods, both in substance and process of learning. BIE model may be appropriate to increase the problem solving skill especially in creating specific products. While PEI may be appropriate models for science and engineering teaching, but less suitable for building construction drawing course.

Description of the five models of PBL is shown that two models of Hamilton and Schneider are the appropriate approach to be implemented at BCD 2 course. However, Schneider model is the most appropriate, both in “substance of procedure" or "order of procedure" to be used.

Schneider PBL models organized learning process into four steps: getting the start, the initial team activity, project implementation, and completion. In the first step (getting start) learning activities carried out by discussing the project, time limits, method of assessment, resources, requirements and team building. In the second step (initial activity), the learning is done by setting the specifications of the project, formulation of

objectives, targets and time planning, teacher feedback mechanism, revision of specifications and do plans. In the third step (take action), the learning process needs to pay attention to the following activities: a) control the student to complete the task within the allotted time, b) ensure that students are involved in regular meetings, c) conduct task improvement, d) ensure sharing among team members, e) conduct feedback, and f) problem solving. In the fourth step (completion), each student must: a) complete a final project and prepare a presentation, b) involved in the class room assessment activity in order to get suggestions from all participants, and c) involved in the closing activity to share project experience. Conversion of conventional learning models into models of Schneider described the scheme in the form below.

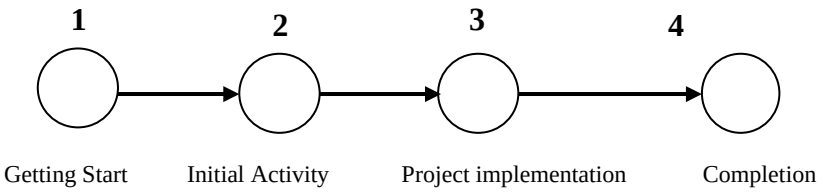

Figure 1. Procedure of Schneider's PBL Model

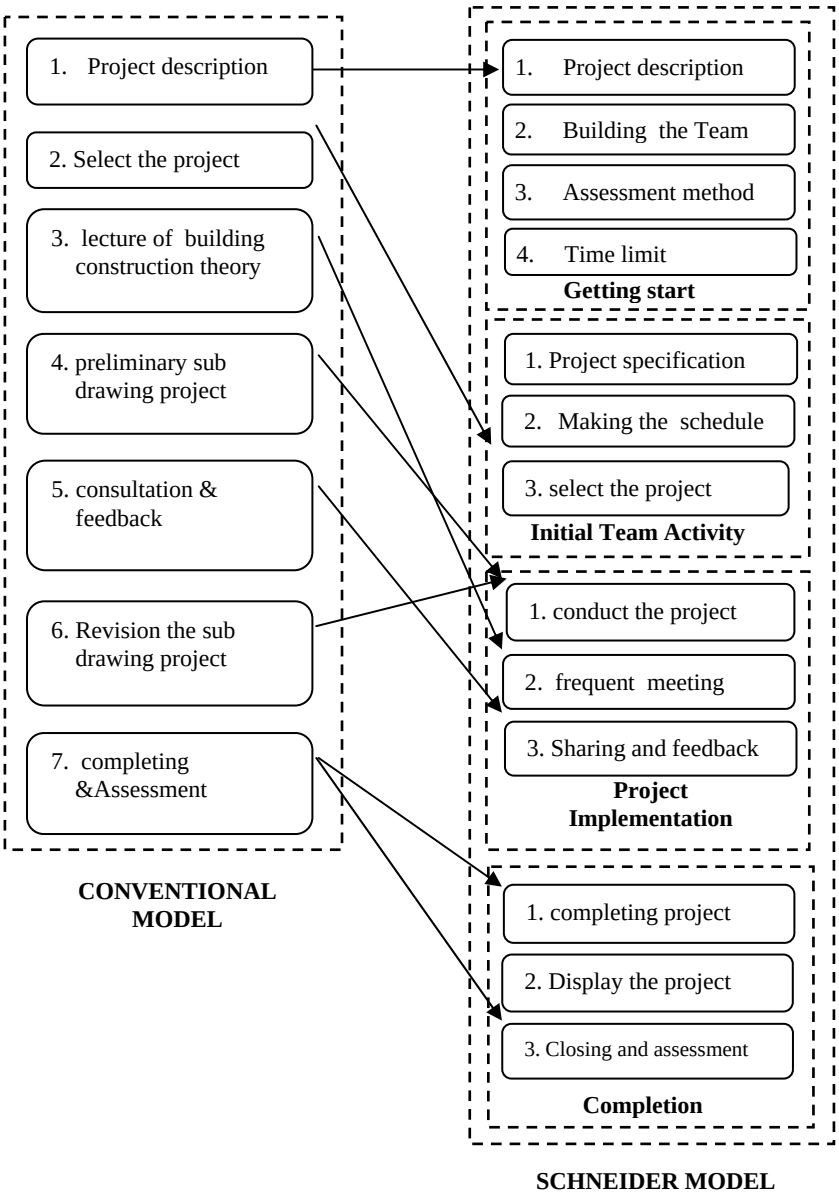

Figure 2. Conversion of cConventional Model into Schneider's PBL Model

The study of a modified Schneider PBL model that implemented at BCD 2 course getting some findings follows: a) the performance of the group will be effective as group members are relatively equal ability, b) initial students do not have adequate knowledge of building construction, making them less able to provide significant input to the discussions in groups c) a group with insufficient construction knowledge, tend to be late in completing their tasks. Both provision of theoretical knowledge of building construction and field work project can improve students' knowledge significantly, d) Project construction drawings are composed of serial types of sub-projects, each of which can be completed separately but sequentially e) each sub-project implemented through the draft design drawings of the project, sharing in the classroom, feedback, revision, and completion. This means that all projects are carried through the model of Schneider with repeated cycles in each sub-project, f) assessment process allowing for peer assessment among students as a consideration for the teacher to determine final score, g) at the phase of completion, all projects of each group presented and displayed in the classroom to get an appreciation of other groups, h) to improve the standard or quality of the project drawing and to encourage discussion within the group, it is recommended that each group has a professional project drawing document.

4. Recommendation

Some results obtained in this classroom action research should be considered in the pre-model preparation of project-based learning for building drawing construction course. This pre-model of project based learning modified from Schneider model is proposed in accordance with the characteristics of learning project that composed of sub-projects which each possible to be completed separately but sequentially.

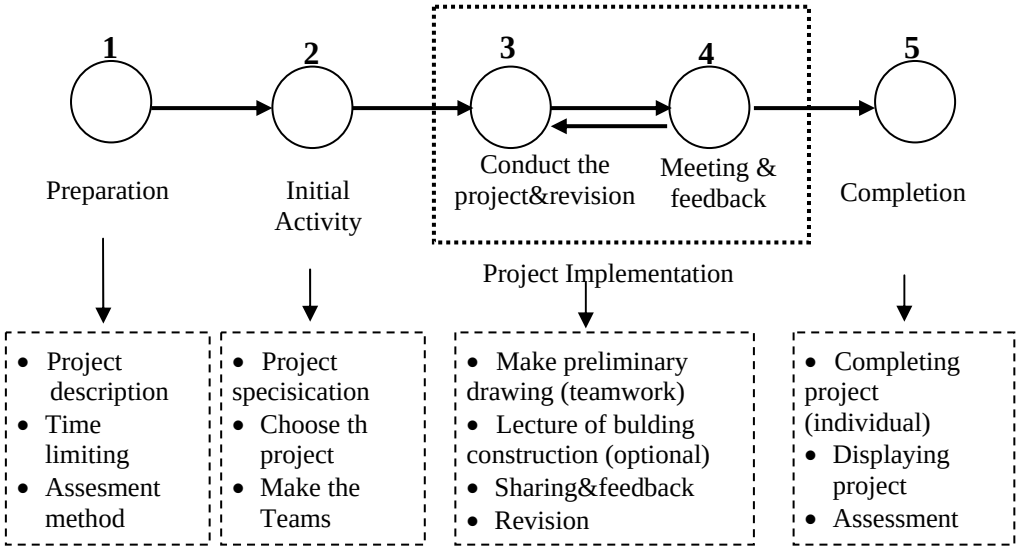

Figure 3. The Modified Schneider PBL Model for Building Construction Drawing Course

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